Dog Excrement as a Factor in Community Fly Problems

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INTRODUCTION

Although investigations of urban fly-breeding media have been reported from a number of American communities, comparatively little attention has been paid to the significance of dog excrement as a source of flies. In many residential areas, this material and kitchen refuse are the only fly-producing materials of any consequence to be found. Yet, specific information about the flies attracted to and breeding in dog feces is scarce. Graenicher (1931) reported rearing a sarcophagid, *Sarcophagula occidua* (Fabricius), from dog excrement exposed to natural infestation at South Miami, Florida. In Savannah, Georgia, Quarterman et al. (1949) found that dog feces ranked next to garbage cans in neighborhood fly production. These authors recorded *Sarcophaga* spp. as the most numerous flies reared from 123 naturally infested deposits. Schoof et al. (1954) and Siverly and Schoof (1955) briefly discussed dog droppings as one of the fly-producing media prevalent in Charleston, West Virginia and Phoenix, Arizona, respectively. In these cities, also, *Sarcophaga* spp. were found to predominate in dog excrement.

The present study was conducted between September 1961 and March 1962 as part of an investigation of fly sources in residential Hawaii by the Environmental Health Division, Hawaii State Department of Health. It represents an attempt to judge the significance of dog feces as a factor in community fly problems.

STUDY AREA AND PROCEDURE

The study area, known locally as Waialae-Kahala, is a high-income residential section of Honolulu. It includes approximately 1,500 homes situated close to Diamond Head on the relatively dry leeward coast of Oahu (annual rainfall less than 25 inches). This neighborhood of ex-

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pensive, carefully maintained homes has a very high level of sanitation. There are no major fly sources nearby, and garbage cans account for only negligible fly production (Wilton 1961). Health Department records show, nevertheless, that residents of this area experience considerable annoyance because of flies. From July 1958 through December 1961 more than one-fifth of the fly complaints received by the Department from Honolulu residents came from this one neighborhood.

In a preliminary survey to gain an idea of the prevalence of dog feces in the study area the front yards of 289 residences in three parts of the neighborhood were inspected. Subsequently, 100 samples of this material were collected from lawns and parking strips throughout the area and placed in one-pint cardboard cans. The samples were covered with dry sand, and plastic emergence cages were attached to the containers. All samples were kept in an outdoor insectary for one month and as adult flies emerged they were identified and counted.

Samples so treated were protected, of course, from the moment of collection from the effects of sun and wind. Consequently, mortality due to drying out of the larval medium could be expected to be considerably less than normal. To investigate the effect on emergence of exposure to natural conditions during dry weather over a period of several days, two series of rearings were set up. In the first of these, 20 fresh deposits of dog feces were collected from pens at the Animal Quarantine Station of the Hawaii State Department of Agriculture and Conservation. These were placed in shallow carboard containers made by cutting down pint canisters to a height of 2 inches. The containers were placed uncovered inside empty gallon cans which were put on a table in an unshaded place. Ants were excluded by placing the table legs in cans of water and flies were allowed free access to the samples for six days. To ensure maximum exposure of the sample to sun and wind, each container was raised approximately level with the rim of the can by means of an inverted pint jar. An inch of dry sand provided a pupation medium for any migrating pre-pupal larvae trapped in the cans. No water was added to these samples during the exposure period except for 0.15 inch of rain. After exposure, the samples, together with the contents of the gallon cans, were held for three weeks in the insectary. A second series of 10 fresh samples from the same source was treated exactly like the first except that on the fourth day of exposure 1.0 ml. of tap water per 10.0 grams initial sample weight was added to each sample. In addition, this group received 0.08 inch of rain. Again, adult flies were identified and tallied as they appeared.

To obtain information concerning the species of flies attracted to the area, a small trap as described by Joyce (1958) was baited with dog excrement and hung from the edge of the table on which the fecal samples were exposed. The trap was operated for three days and the bait was kept moist during this time.

RESULTS

The preliminary survey of the neighborhood revealed that one or more deposits of dog excrement were present in the front yards of 57 percent of the 289 residences inspected. Multiple deposits were commonplace, as many as five being noted on a single lawn. Hence, no difficulty whatever was encountered in obtaining 100 samples for rearing. No special attempt was made to determine before collection whether the samples were infested or not but obviously old and dry material was avoided. Eighty-six of the samples yielded adult flies belonging to seven species. Table 1 presents the results of this series of rearings. The number of flies obtained from a single deposit varied from zero to 927; the average was 174.5.

TABLE 1.—Flies Reared from 100 Samples of Dog Feces in Honolulu

Species	Number reared	Percent of total	Average per Sample	Samples Infested
Musca domestica Linnaeus	11,714	67.1	117.1	63
Sarcophagula occidua (Fabricius)	4,073	23.3	40.7	82
Musca sorbens Weidemann	1,538	8.8	15.4	41
Bercaea (Sarcophaga) haemorrhoidalis (Fallén)	81	0.5	< 1.0	8
Anthomyia bisetosa Thomson	24	0.1	< 1.0	2
Fannia pusio Wiedemann	17	< 0.1	< 1.0	4
Chaetoravinia anandra Dodge	4	< 0.1	< 1.0	1
Total	17,451		174.5	86

The samples subjected for nearly a week to the action of sun and wind appeared thoroughly dry at the end of the exposure period and, as shown in Table 2, the reduction in numbers of adults produced was marked. The samples which received no water (except for the 0.15 inch

TABLE 2.—Flies Reared from Dog Feces Samples Exposed for Six Days

Species	Group 1: 20 Samples No water added 0.15 inch rain		Group 2: 10 Samples 1.0 cc water per 10.0 gms. 0.08 inch rain	
	Total	Number per sample	Total	Number per sample
Musca sorbens	472	23.6	175	17.5
Sarcophagula occidua	78	3.9	1213	121.3
Bercaea haemorrhoidalis	48	2.4	7	0.7
Total	598	29.9	1395	139.5

of rain) yielded an avearage of 29.9 flies each in sharp contrast to the 174.5 per sample obtained from the first series of rearings. As further indication of the critical importance of moisture, a single addition of water at the rate of 1.0 ml. per 10 grams of medium was sufficient to increase the number of adult flies per sample to 139.5 in the second group.

The trap catch is tabulated in Table 3.

DISCUSSION AND CONCLUSIONS

Three species, *Musca domestica*, *Sarcophagula occidua*, and *M. sorbens*, account for 99 percent of the flies reared from naturally infested samples of dog feces collected in the study area. This is in contrast with reports from the mainland United States which have listed *Sarcophaga* spp. as the principal inhabitants of dog excrement (Quarterman et al. 1949, Schoof et al. 1954, Siverly and Schoof 1955).

TABLE 3.—Three-Day Catch of Flies in Trap Baited with Dog Feces Honolulu, February 1962

Species	Total	Male	Female
Physiphora aenea Fabricius	507	247	260
Chrysomya megacephala (Fabricius)	187	89	98
Sarcophagula occidua (Fabricius)	149	46	103
Musca domestica Linnaeus	125	18	107
Atherigona orientalis (Schiner)	35	—	35
Phaenicia cuprina (Wiedemann)	25	7	18
Synthesiomyia nudiseta Van der Wulp	23	—	23
Ophyra chalcogaster Wiedemann	17	—	17
Fannia pusio Wiedemann	10	—	10
Bercaea (Sarcophaga) haemorrhoidalis (Fallén)	6	3	3
Acrosticta apicalis (Williston)	5	1	4
Gitonides perspicax Knab	3	—	3
Helicobia morionella (Aldrich)	3	—	3
Anthomyia bisetosa Thomson	2	—	2
Milichiella lacteipennis Loew	2	—	2
Musca sorbens Wiedemann	2	—	2
Euxesta quadrivittata Macquart	1	—	1
Chrysomya rufifacies Macquart	1	—	1
Parasarcophaga argyrostoma (Robineau-Desvoidy)	1	—	1
Total	1104	411	693

Musca domestica has been part of the Hawaiian insect fauna for many years (Grimshaw 1901) but *M. sorbens* and *Sarcophagula occidua* are of recent advent. *M. sorbens* was first recorded here by Joyce in 1950 and *S. occidua* was not reported until 1962 (Joyce and Wilton). *M. sorbens* is reported to breed in a rather wide variety of media including garbage (de la Paz 1938), various animal manures (Patton 1936, Bohart and

Gressitt 1951) and human excrement (Buxton and Hopkins 1927, Sabrosky 1952, Gaud et al. 1954). According to Bohart and Gressitt (1951), in West China, Meng and Winfield (1944) found dog droppings to be an important breeding medium for *M. sorbens* and it is of interest to find that species showing the same behavior in Hawaii. *Sarcophagula occidua* also exhibits considerable latitude in its choice of breeding media. Hall (1933) referred to this species as "a scavenger and an excrement feeder." Graenicher (1931) reported rearing it once each from rotten beef and dog excrement in Florida, and Haines (1953, 1955) bred it in Georgia from a variety of materials including carrion, animal excrements, and fruit and vegetable wastes. Dog feces appears to be highly suitable for its development.

The enormous fly-production potential of this material is well demonstrated by the average production of 174.5 adult flies per deposit obtained in the present study. Fortunately, this potential is not always realized. Under natural conditions dehydration is probably the principal factor limiting fly production from this material. Predation by ants often becomes important in relatively permanent fly-breeding sites such as garbage cans (Phillips 1934, Pimentel 1955) but in more temporary media such as dog droppings this factor is seldom effective. During the collection of the 100 samples used in the present study, plus some 30 more in two other Honolulu neighborhoods, ants were observed attacking fly larvae in dog feces only once.

The failure of *Musca domestica* to emerge from any of the 30 samples which underwent six days of exposure to sun and wind, before being brought into the insectary, is noteworthy. It suggests that this species is more susceptible than others to dehydration of the larval medium.

In addition to serving as a breeding medium, dog feces strongly attract a number of flies which apparently do not breed in it. Of the 19 species which were attracted to dog excrement (Table 3) 13 were not reared from any of the samples.

In view of the frequency with which *M. sorbens* was bred (41 times from 100 samples) the appearance of only two individuals of this species in the trap catch was unexpected. The most likely explanation is provided by the trap itself. The lower portion of the trap in which the bait was placed was made from a tin can. Three evenly spaced retangular openings were cut in the side of the can. The top edge of each rectangle was left uncut and the resulting flap was bent upward. This arrangement allowed access by flies to the bait while excluding rain but made the interior of the bait container rather dark. *M. sorbens* is said to enter houses rarely. The relative darkness of the bait container may likewise have discouraged it from entering the trap.

Dog excrement is a highly productive fly-breeding medium which may be present in considerable quantity in residential areas. It is very attractive to many species of flies and usually becomes heavily infested with fly larvae. Although deposits of this material dry rapidly, which sharply

curtails fly production, rain and frequent watering of lawns allow many of the larvae to complete their development. The annoyance caused by flies from this source prevents full enjoyment of many outdoor activities, particularly those entailing the cooking or serving of food in unscreened areas. Fly annoyance is especially great where *Musca sorbens* is present, as this fly is strongly attracted to sweat and is very persistent and difficult to discourage. Moreover, its fondness for any body exudate and for sores gives it considerable public health importance. From the public health point of view the frequent existence of *Salmonella* infections in dogs (Stableforth and Galloway 1959, pp. 523–524) lends further significance to the presence of dog feces in residential areas. Flies, notably houseflies, have been repeatedly incriminated in the mechanical transmission of enteric infections including salmonellosis (Faust and Russell 1957, p. 870).

The conclusion appears inescapable that dog feces must be considered a very significant factor in community fly problems.

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